A Comparative Study of the Winding Type Influence on the Noise Level of Two-Speed Three-Phase Induction Motors: review and perspective

R. M. Ionescu¹, A. Munteanu²

¹LMS Romania S.R.L., ²“Transilvania” University of Brasov, Romania

Abstract

The goal of this work is to present the study of the influence of the winding – double layer or single layer – to the global noise level of an induction motor. For this purpose, two variable speed induction motors have been studied, of the type M3AA 71 B2/4 manufactured by Electroprecizia S.A. Săcele, Romania, with Dahlander windings, star connected - for the low speed and double star connected – for the high speed. The motors are modelled from magnetic and mechanical point of view with finite element softwares. The noise-to-frequency characteristics have been determined by investigations in a semi-anechoic chamber.

In this paper, the purpose is to study the influence of the type of winding [3,4] – double layer or single layer – to the global noise level of the machine. These numerical methods must be integrated in the fabrication process for testing, verifying and validating different solutions offered by the designer of electrical machines [5]. Furthermore, the simulations allow the reduction of the number of prototypes to be studied before passing to the fabrication stage, and thus lowering the costs and the research time for development.

For this purpose, two variable speed induction motors have been studied, of the type M3AA 71 B2/4 manufactured by Electroprecizia S.A. Săcele, Romania. The machines are two-speed induction motors, Dahlander windings, star connected - for the low speed and double star connected – for the high speed. The motors are supplied at the rated voltage of 400V and the network frequency of 50 Hz.

An electromagnetic analysis has been performed using the Cedrat FLUX 2D software – for determining the magnetic pressure exerted on the stator surface and a mechanical analysis using the ANSYS 3D modelling [6] – for determining the natural vibration frequencies of the stator-case group, the most important mechanical noise radiators. By comparing the harmonic spectrum obtained from the FLUX 2D magnetic analysis with the spectrum obtained from the ANSYS 3D mechanical analysis, common peaks could be identified.

The two-speed M3AA 71 B2/4 induction motor has been acoustically measured for both connections and the results are presented comparatively for the 2 types of winding. The global noise level was measured in a semi-anechoic chamber for each type of the studied two-speed induction motors, by using a Class 1 Brüel&Kjaer soundmeter. The measured sound pressure levels belong to the limit values predicted by the IEC 34-9 International Standard, for electrical machines with powers less than 2.2 kW (71 dB). Furthermore, the simulations and measurements allow the manufacture to reduce the number of prototypes to be studied before passing to the fabrication stage, and thus lowering the costs for research and development.

References